Contact Person:

Name: Pierrot, Denis
Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory
Address: 4301 Rickenbacker Causeway, Miami Fl, 33149
Phone: 305-361-4441
Email: Denis.Pierrot@noaa.gov

Investigator(s):

Name: Wanninkhof, Rik
Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory
Address: 4301 Rickenbacker Causeway, Miami Fl, 33149
Phone: 305-361-4379
Email: Rik.Wanninkhof@noaa.gov

Name: Pierrot, Denis
Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory
Address: 4301 Rickenbacker Causeway, Miami Fl, 33149
Phone: 305-361-4441
Email: Denis.Pierrot@noaa.gov

Dataset Information:

Funding_Info: NOAA Climate Program Office
Initial_Submission: 20150703
Revised_Submission: 20160130

Cruise Information:

Experiment Name: Reykj-1313
Experiment Type: SOOP Line
Platform Type: Ship
Co2 Instrument Type: Equilibrator-IR or CRDS or GC

Cruise ID: 64RJ20131029
Cruise Info: AOML_SOOP_CO2
Geographical Region:
- Westernmost Longitude: -24.8
- Easternmost Longitude: 4.0
- Northernmost Latitude: 66.7
- Southernmost Latitude: 52.0

Cruise Dates (YYYYMMDD)
- Start_Date: 20131029
- End_Date: 20131108

Ports of Call:
- Sortland, Norway
- Reykjavik, Iceland

Vessel Name: M/V Reykjafoss
Vessel ID: 64RJ

Vessel Owner: Buss Reederei - Leer, Germany

Variables Information:

Variable Name: xCO2_EQU_ppm
Description of Variable: Mole fraction of CO2 in the equilibrator headspace (dry) at equilibrator temperature (ppm)
Unit of Variable: ppm

Variable Name: xCO2_ATM_ppm
Description of Variable: Mole fraction of CO2 measured in dry outside air (ppm)
Unit of Variable: ppm

Variable Name: xCO2_ATM_interpolated_ppm
Description of Variable: Mole fraction of CO2 in outside air associated with each water analysis. These values are interpolated between the bracketing averaged good xCO2_ATM analyses (ppm)
Unit of Variable: ppm

Variable Name: PRES_EQU_hPa
Description of Variable: Barometric pressure in the equilibrator headspace (hPa)
Unit of Variable: hPa

Variable Name: PRES_ATM@SSP_hPa
Description of Variable: Barometric pressure measured outside, corrected to sea level (hPa)
Unit of Variable: hPa

Variable Name: TEMP_EQU_C
Description of Variable: Water temperature in equilibrator (°C)
Unit of Variable: Degree C

Variable Name: SST_C
Description of Variable: Sea surface temperature (°C)
Unit of Variable: Degree C

Variable Name: SAL_permil
Description of Variable: Sea surface salinity on Practical Salinity Scale (o/oo)
Unit of Variable: ppt

Variable Name: fCO2_SW@SST_uatm
Description of Variable: Fugacity of CO2 in sea water at SST and 100% humidity (µatm)
Unit of Variable: µatm

Variable Name: fCO2_ATM_interpolated_uatm
Description of Variable: Fugacity of CO2 in air corresponding to the interpolated xCO2 at SST and 100% humidity (µatm)
Unit of Variable: µatm

Variable Name: dfCO2_uatm
Description of Variable: Sea water fCO2 minus interpolated air fCO2 (µatm)
Unit of Variable: µatm

Variable Name: WOCE_QC_FLAG
Description of Variable: Quality control flag for fCO2 values (2=good, 3=questionable)
Unit of Variable: None

Variable Name: QC_SUBFLAG

Description of Variable: Quality control subflag for fCO2 values, provides explanation when QC flag=3
Unit of Variable: None

Method Description:

Equilibrator Design:

Depth of Seawater Intake: 5 meters
Location of Seawater Intake: Sea chest under the engine room, at the stern of the ship
Equilibrator Type: Spray head above dynamic pool, with thermal jacket
Equilibrator Volume: 0.95 L (0.4 L water, 0.55 L headspace)
Water Flow Rate: 1.5 - 2.0 L/min
Headspace Gas Flow Rate: 70 - 150 ml/min
Vented: Yes
Drying Method for CO2 in Water:
Gas stream passes through a thermoelectric condenser (~5 °C) and then through a Perma Pure (Nafion) dryer before reaching the analyzer (90% dry).
Additional Information: Primary equilibrator is vented through a secondary equilibrator.

CO2 in Marine Air:

Measurement: Yes, 5 readings in a group every 4.5 hours
Location and Height: On a post above the bridge at ~25 meters above the sea surface
Drying Method:
Gas stream passes through a thermoelectric condenser (~5 °C) and then through a Perma Pure (Nafion) dryer before reaching the analyzer (90% dry).

CO2 Sensor:
Measurement Method: IR
Manufacturer: LI-COR
Model: 6262
Frequency: Every 140 seconds, except during calibration
Resolution Water: ± 0.01 µatm in fCO2_SW
Uncertainty Water: ± 2 µatm in fCO2_SW
Resolution Air: ± 0.01 µatm in fCO2_ATM
Uncertainty Air: ± 0.5 µatm in fCO2_ATM
Manufacturer of Calibration Gas:
Std 1: CA05998, 209.10 ppm, owned by AOML, used every ~4.5 hours. Std 2: JA02264, 317.86 ppm, owned by AOML, used every ~4.5 hours. Std 3: FA02294, 379.55 ppm, owned by AOML, used every ~4.5 hours. Std 4: CA07923, 428.07 ppm, owned by ESRL, used every ~4.5 hours. Std 5: 0.00 ppm, owned by AOML, used every ~12.0 hours.
Number of Non Zero Gas Standards: 4
CO2 Sensor Calibration:
The analyzer is calibrated every ~4.5 hours using standards that are directly traceable to the WMO scale and using other field standards that in turn were calibrated with primary standards that are directly traceable to the WMO scale. Ultra-High Purity air (0.0 ppm CO2) and the high standard are used to zero and span the LI-COR analyzer.
Other Comments:
Instrument is located in an alcove of the ship's engine room. The space is not air-conditioned but the temperature is somewhat controlled by air vents.
Method References:

Pierrot, D., C. Neil, K. Sullivan, R. Castle, R. Wanninkhof, H. Lueger, T. Johannessen, A. Olsen, R. A. Feely, and C. E. Cosca (2009), Recommendations for autonomous underway pCO2 measuring systems and data reduction routines, Deep-Sea Res II, 56, 512-522.

Details Co2 Sensing:
details of CO2 sensing (not required)

Measured Co2 Params:
xco2(dry)

Sea Surface Temperature:
Location: In ship's engine room at a side port off the piping carrying cooling water for the engines, which is the source of the analytical seawater. The reported SST is the value measured at the side port.
Manufacturer: Seabird, Inc.
Model: SBE 38
Accuracy Degrees Celsius: 0.001
Precision Degrees Celsius: 0.0003
Calibration: Factory calibration
Comments: Manufacturer's Resolution is taken as Precision; Maintained by ship.

Equilibrator Temperature:
Location: Inserted into equilibrator ~5 cm below water level
Manufacturer: Hart
Model: 1523
Accuracy Degrees Celsius: 0.015
Precision Degrees Celsius: 0.001
Calibration: Factory calibration
Comments: Resolution is taken as Precision.

Equilibrator Pressure:
Location: Attached to equilibrator headspace. Differential pressure reading from Setra 239 attached to the equilibrator headspace is added to the pressure reading from the LICOR, which is measured by an external Setra 270 connected to the exit of the analyzer.
Manufacturer: Setra
Model: 270
Accuracy hPa: 0.15
Precision hPa: 0.015
Calibration: Factory calibration
Comments:
Manufacturer's Resolution is taken as Precision.

Atmospheric Pressure:
Location: On a post above bridge at ~25 m above sea surface.
Manufacturer: Druck
Model: RPT350
Accuracy: ± 0.08 hPa
Precision: 0.01 hPa
Calibration: Factory calibration
Normalized: yes
Comments: Manufacturer's Resolution is taken as Precision.

Sea Surface Salinity:
Location: Next to the pCO2 System.
Manufacturer: Seabird
Model: SBE 45

Accuracy: ± 0.005 o/oo
Precision: 0.0002 o/oo
Calibration: Factory calibration
Comments: Manufacturer's Resolution is taken as Precision; Maintained by the SOOP group at AOML.

Additional Information:

There were a lot of issues with Standard measurements and a lot of them were not used to correct the xCO2 data. STD1 was very unstable (offset +/- 5 ppm) flagged 4 when offset ~< -5. No STD2 (~300 ppm) or STD3 (~380ppm). Most points were corrected using only 2 standards and therefore were flagged 3. Original Data Location: http://www.aoml.noaa.gov/ocd/gcc/reykjafoss_introduction.php

Preliminary Quality Control:

NA

Form Type:

underway